those of the solvent required, because the effect of transpiration of more of the solvent into the solution is not in any way to alter the individual complexes. The change in available energy of the system, on dilution, thus solely arises from the expansion of the complexes into a larger volume; and it can be traced into exact correlation with the change of available energy that occurs in the expansion of a gas. This argument meets the objection that a true theory should involve a knowledge of the molecular actions between the various molecules. It would seem that with just the same cogency it might be argued that a real investigation of the connection of the alteration of the freezing-point of a liquid by pressure, and its change of volume on freezing, should involve a knowledge of the individual molecular actions in the liquid; and so it would, had we not the means of evading molecular considerations that is afforded by Lord Kelvin's great principle of availability, which is for this very reason at the basis of all physical theory.

There is, however, one point to be remembered, namely, that the theoretical osmotic pressure is a limiting value which may not be reached by an actual arrangement, unless we can be certain that it works reversibly, and so without heating effects.

The remark has been made by Lord Kelvin, that the connection between Henry's law and the osmotic law must break down when the solution of the gas is accompanied by change in its state of molecular aggregation. It is also probable, from the fundamental ideas as to dissociation and aggregation, that such change would usually be partial, and not uniform over all the dissolved molecules; so that it is not to be expected that Henry's law would, in such circumstances, hold good. The point in which the argument, as set forth in precise form by Lord Rayleigh (NATURE, *loc. cit.* p. 254), becomes then inapplicable, is that the gas expelled from solution by the osmotic process must be considered as emerging in the actual state of aggregation differing from that of its free condition, and its return to the latter state involves further change of available energy.

If the considerations above stated, which will be most suitably developed in detail in another connection, are valid, it follows that Prof. Poynting's recent suggestion (*Phil. Mag.*, October 1896), with a view to evading the necessity of the ionic dissociation hypothesis, cannot avail, as it would not lead to the desired value for the osmotic pressure; that pressure depends on the number of molecular complexes involving the dissolved substance, that exist in the dilute solution, but not on their individual degrees of complexity.

THE OSTRICH.[1]

THE ostrich, *Struthio camelus*, has been observed with interest from very early times; it has frequently been the subject of remark by African travellers; and it has been domesticated and farmed in the Cape Colony for some thirty years. Yet it is remarkable how little is known about it in scientific circles, and how many misconceptions still prevail as to its nature and habits.

This article is founded on personal observations made during nine years of uninterrupted ostrich-farming in the Karroo of the Cape Colony, and during travels about the country generally. In large ostrich camps, some of which are a couple of miles in diameter, numbers of birds of both sexes run in what is practically a wild state, seldom interfered with in any way, except when rounded up to be plucked or to be fed in a drought. The habits of birds thus farmed differ in no way from those of native wild birds, except perhaps that monogamy is more difficult.

NUMBER OF SPECIES.

All the differences on which the arguments for classifying the ostrich into three species are founded, are commonly present among the ostriches of the Cape Colony—that is, of South Africa generally; for a great many of the Cape ostriches are the progeny of birds brought down from "The Interior"—the Kalahari Desert, Damaraland, and beyond. There is, I think, little doubt that all South African ostriches are of one species; individual variations, accentuated by local differences of food and climate, are quite sufficient to account for all supposed varieties. I do not think that, on the evidence which I have been able to gather, there is any justification for maintaining that there is more than one species of ostrich.

THE EGG OF THE OSTRICH.

The ostrich hen lays every other day, and the egg weighs about three pounds; it is a tasty and nutritious food however prepared, very rich, and excellent for making pastry and cakes. It is generally computed to be equal to two dozen fowls' eggs; but this must be on account of its superior richness, for, from personal experiment, the empty shell of a fairly large one exactly held the contents of eighteen fowls' eggs. It takes about forty minutes to boil an ostrich egg hard. The period of incubation is about six weeks.

LEAPING AND SWIMMING.

The old idea that an ostrich can only leap over a very low fence, or across but the narrowest sluit (gully), is incorrect. The birds will, when startled (never deliberately), sometimes go over a six-strand wire fence nearly five feet high, putting one foot on one of the middle wires, and striding over with the other. They will go over a stone wall in the same manner, if too high for them to step upon; and I have seen a cock take a standing jump on to the top of a wall five feet high, beyond which were his chicks.

Even as a chick the ostrich is a powerful swimmer. I have known several birds swim some distance down the Great Fish River when it was running fairly strong, and have heard, on what seems trustworthy evidence, of a cock that was carried a long way down the same river when it was running nearly level with its precipitous banks in the stormy season; he was some hours in the water before he could get out, but emerged unhurt.

HOW IT FEEDS, AND WHAT IT WILL SWALLOW.

The ostrich feeds in a peculiar manner. It tosses the food into a sack in the upper part of the neck, and then swallows it. I have seen a bird toss fully a quart of mealies (Indian corn) into this sack before swallowing; and it is no uncommon thing to see two "swallows" travelling down the neck at the same time with a clear interval between them; or to see one of them (if of large and loose food, *e.g.* grain) slide back into the sack after being swallowed, if the bird lowers its head to continue feeding before the food has travelled some considerable distance down the neck. The food travels slowly, and performs a complete circuit of the neck before reaching the crop. Crushed bones are greedily eaten; if too large a piece should stick in the neck, it is a simple matter to cut it out and sew the wound up again. The wound, as a rule, heals quickly, and causes but little inconvenience. As is well known, ostriches will swallow almost anything small enough to pass down the neck. An ostrich's crop always contains a large quantity of smooth stones, many of them brightly coloured.

HOW THE OSTRICH RUNS.

Considerable misconception prevails as to the manner in which the ostrich runs. It seems to be still generally held that, when running, it spreads out its wings, and, aided by them, skims lightly over the ground. This is not correct.

When a bird really settles itself to run it holds its head lower than usual, and a little forward, with a deep loop in the neck. The neck vibrates sinuously, but the head remains steady, thus enabling the bird, even at top speed, to look around with unshaken glance in any direction. The wings lie along the sides about on a level with, or a little higher than, the back, and are held loosely just free of the plunging "thigh." There is no attempt to hold them extended, or to derive any assistance from them as organs of flight.

When an ostrich, after a long run, is very tired, its wings sometimes droop; this is due to exhaustion; they are never, by a running bird exerting itself to the utmost, held out away from the sides to lighten its weight or to increase its pace. But the wings appear to be of great service in turning, enabling the bird to double abruptly even when going at top speed.

THE NEST.

As the breeding season approaches, a cock and hen will pair, and, having selected a site congenial to their inclinations,

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[1] Abridged from a long article, by S. C. Cronwright Schreiner, in the March number of *The Zoologist*.

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proceed to make a nest. I believe that in all cases, in the first instance, one cock and one hen, having paired, select the site and make the nest.

The nest is simply a hollow depression, more or less deep according to the nature of the soil. It is made by the pair together. The cock goes down on to his breast, scraping or kicking the sand out backwards with his feet, cutting the earth with his long and powerful nails. The hen stands by, often fluttering and clicking her wings, and helps by picking up the sand with her beak, and dropping it irregularly near the edge of the growing depression.

LAYING AND SITTING.

When satisfied with their work (and they are easily satisfied, often too easily) the hen begins to lay an egg in the nest, every other day. During the laying period the nest is often unattended, and is not slept on at night. A nest in which only one hen is laying contains on the average about fifteen eggs; but she often begins to sit before she has laid her full complement. Sometimes she will lay four or five after beginning to sit, though not often so many; sometimes only one or two; while sometimes she will lay her full complement. The hen generally begins the sitting; she will occasionally sit for one or two days and nights before the cock takes his turn. When sitting assumes its regular course, the hen sits from 8 or 9 a.m. to about 4 p.m., and the cock from 4 p.m. to about 8 or 9 a.m. The bird whose turn it is to be on the nest keeps its seat until the other arrives to relieve it, when they at once change places.

It is quite incorrect to say that the cock alone sits, or that during the day the eggs are left to the heat of the sun. The cock and hen sit alternately, regularly and steadily, night and day, during the whole period of incubation.

PROTECTIVE COLOURATION.

The colour of each is admirably adapted to the time spent on the nest, and furnish interesting examples of protective colouration. It is scarcely possible to conceive a more effective disguise than the sober brownish grey of the hen for day sitting, and the black of the cock for night. When on the nest, the ostrich lays its head, neck, and tail flat along the ground; its naked "thighs" are covered by the wings, the plumes lying close together on the earth almost hidden against the bird's body. Thus only the low, long-curved body projects above the surrounding level. The cock, at night, is, of course, almost perfectly hidden; while the hen, at day-time, closely resembles a stone, bush, ant-heap, or any little inequality of the veld. One is surprised to see how close such a large bird can lie to the ground, and how even an ostrich-farmer may almost walk over a sitting hen in full daylight without seeing her. The cock is simply indistinguishable at night, except to a practised eye, and then only at a few yards distance.

IS THE OSTRICH POLYGAMOUS?

Every authority that I have consulted holds that the ostrich is polygamous, but the evidence against polygamy is very strong: a pair make the nest; the hen lays all her eggs (a full sitting) in that nest; the hatching of the eggs and the care of the chicks are shared equally by cock and hen; the cock loses his sexual vigour and ceases his attentions to the hen, soon after beginning to sit; and one hen to a nest yields the best results.

I do not, however, think it can be maintained that the monogamy of the ostrich is proved absolutely, but I decidedly think that the arguments in its favour are much stronger than those in support of polygamy.

CURIOUS AND EXCEPTIONAL RELATIONS.

Finally, it must be allowed that, while all the facts at my command point strongly to the conclusion that the ostrich is not only often monogamous, but that monogamy is the only condition perfectly favourable to the successful hatching and rearing of young; and that all the arguments in favour of polygamy break down on examination: yet the fact remains that there are a large number of curious and exceptional circumstances connected with the nidification, sexual relations, and parental habits of ostriches that I am not yet exactly able to account for, either on the supposition of fully organised monogamy or polygamy.

NATIONAL MEMORIAL TO JENNER.

THE meeting held on Wednesday, in last week, gave coherence to the scheme for raising a national memorial to Edward Jenner, in celebration of the centenary of the discovery of vaccination. "It was surely high time," said the Duke of Westminster, who presided over the meeting, "that this his native land should rise to the occasion, and at last, after 101 years have passed since the first successful vaccination, take active and effective steps to carefully preserve his great legacy to the world, and to do more—to give every facility for the promotion of science in the direction of the prevention of diseases that afflict mankind." Lord Herschell, in moving the first resolution—"That the present is an appropriate time to inaugurate a work of national utility in honour of Edward Jenner," pointed out that Jenner was the first to illustrate a principle which seemed destined to play an important part in the history of preventive medicine. Surely this alone is a high tribute to Jenner and the value of his discovery. His name is held in reverence by the highest men of science and the most civilised countries in the world. Some of these countries have already commemorated his centenary. Are Englishmen to be behindhand in testifying their admiration of the man, and their sense of the benefits he has conferred on humanity? The resolution was seconded by Prof. Michael Foster, who gave instances of the extension of the Jennerian principle to other diseases by Pasteur and other observers. Sir Alfred Lyall, in supporting the resolution, referred especially to the blessings which vaccination had already conferred upon the people of India. The resolution was then carried unanimously.

Lord Lister moved the next resolution:—"That a subscription be set on foot with a view of promoting, in connection with the British Institute of Preventive Medicine, but in a manner distinguished by Jenner's name, researches on the lines which he initiated." In speaking to the resolution (reports the *British Medical Journal*), Lord Lister referred to a mistake in his address to the British Association at Liverpool. The statement was to the effect that smallpox was unknown in the German army as a result of the revaccination of all recruits. If he had stated that fatal smallpox was absolutely unknown in the German army, it would have been the literal truth. A recent instance of the application of the principle discovered by Jenner was Dr. Koch's discovery that by using the bile of an animal which had died of rinderpest to inoculate a healthy animal, that animal was rendered immune to the pestilence for some months at least, time could alone decide for how long. This was an exact parallel to the discovery of Jenner, and the simplicity of the method was such that it places in the hands of any farmer the possibility of protecting the whole of his herd on the appearance of the first case. Another example was the work now being done in India with regard to plague. Two such examples, both taken from a period so recent, and so brief, were sufficient to prove the practical importance of work of this kind. And it was such work which the British Institute of Preventive Medicine was doing. That Institute had been the first in this country to supply the diphtheria antitoxic serum, the use of which had effected so remarkable a reduction in the mortality of the disease in those cases in which it could be employed early. The Institute had never ceased to improve the serum, until that which was issued now had six times the curative power of that first employed. The Institute also prepared tuberculin, which was capable of rendering such important services to the public health by facilitating the early diagnosis of tuberculosis in cattle; and mallein, which rendered similar services in the case of glanders. The Institute might claim, therefore, to be a work of utility, and it was a national institution, for it had upon its governing body representatives of public bodies in all three kingdoms. Thanks to the generosity of their Chairman, the Institute was in possession of a site upon which, owing also in part to his generosity, it had now nearly completed the erection of a suitable building for carrying on its work. But its income was only some 700*l*. a year; the scope of its work was thus cramped, its officers, who gave their services in the true spirit of scientific devotion, were inadequately remunerated, and, unless a large measure of public support was accorded, the full benefits which the Institute was capable of rendering to the country could not be realised. If the response to the movement inaugurated by that meeting was as liberal as it should be, the Council of the Institute were prepared to agree that its name should be changed to that of the "Jenner Institute." If the response were less generous, they might still hope that the sum received would be sufficient to

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